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A WORD OF APPRECIATION

The Association of Geology Teachers expresses its sincere thanks to Dr. Anastasia Van Burkalow for her distinguished service as Editor of the JOURNAL OF GEOLOGICAL EDUCATION. Under her direction the JOURNAL has achieved a high degree of professional maturity. The entire membership, individually, join President Berg in extending every good wish to Dr. Van Burkalow for success in her other endeavors and in her teaching career.

Journal of Geological Education

Volume 5 Spring 1957 Number 1

CORRELATING THE GEOLOGY CURRICULUM WITH THE GENERAL EDUCATION REQUIREMENTS OF THE COLLEGE

DONALD C. BOARDMAN

Wheaton College

ABSTRACT. The complexity of today's society makes necessary an education adequate to prepare the individual both for the practical aspect of earning a living and for the art of successfully living in the society. This has led to a tendency to divide educational institutions into two categories, "Institutes of Technology" and "Liberal Arts Colleges." The division is invalid, however, since the technical schools recognize their students' need for an appreciation of human and social values, while the graduate of the liberal arts college may have a strong foundation in the sciences and mathematics. The development of a closer liaison between the science departments and the faculties of humanities and social studies would result in mutual benefits.

The concept of a liberal education came with the advance of civilization. Primitive society taught its members those things which were necessary for survival. It was not necessary to spend much time in learning about the society, as it consisted of very few persons. As society became more complex, education, of necessity, concerned itself with helping the individual not only to survive, but to get along with other citizens. The complexity of today's society and the necessity for an adequate education that fills the need of the individual both technically and sociologically is recognized by all. Industry is aware that the most productive employees are those best adapted to their society. We are also cognizant of the fact that a worker at any level can make the best contribution when he knows not only his own job but its relation to others in the company.

We are tempted at times to divide all educational institutions into two classes: those known as liberal arts colleges (including the liberal arts and science colleges of the universities) and the technical schools. It is interesting to note, however, that the so-called technical schools recognize the need for a broader education than the purely technical subjects which are taught. The 1956 catalogue of the Massachusetts Institute of Technology says, "Humanities and Social Sciences are an integral part of the education at M. I. T. Their purpose in the curriculum is to impress upon the student how important human relationships are in a society and to develop in him the first rate human and social values which must accompany technical confidence if an individual is to make his maximum contribution as a citizen." This fall, speaking before the American Chemical Society at Atlantic City, Dr. John C. Warner, President of Carnegie Institute of Technology, said, "Chemistry, should have an effective and adequate program of liberal studies as an integral part of the student's professional education." It is obvious, therefore, that not only the liberal arts colleges but also the technical schools are aware of the need for a general education requirement for graduation. This basic philosophy must be recognized by geological educators as well as the fact that our colleges and

industry are demanding that students receive training outside of the geology department. The geology faculty is aware of this need but often finds it difficult to manipulate the student's schedule to work in the general education requirements and still enroll him in those geology and related science courses that seem necessary.

Although it is very difficult to make comparisons with requirements of various colleges because of the different terminology and credits given for courses, a survey of a large number of college catalogues indicates that the average general education requirement might be thus summarized: English Language and Composition 12 semester hours, Literature 8 semester hours, Social Science 10 semester hours, Humanities 12 semester hours, and Foreign Language 16 semester hours.

In addition to this, most church-related schools (and many liberal arts colleges have had denominational affiliations) require a certain amount of religious training.

If courses in these general subjects had no relationship at all to science in general or geology in particular, they would still have value for a student. However, students, as well as faculty, should try to see the connection and make applications of a geologic nature where possible. We are fortunate that in many schools the faculties in the areas of general requirements recognize that they are service organizations and attempt to train the student in a practical manner. When students in geology write reports we appreciate those who have been adequately trained in composition and spelling. It might be well for us, therefore, to make a concerted effort to inform our English professors that we are interested in having our majors well trained in their field. In many schools it has been possible for geology majors to write compositions dealing with geologic subjects. In one school with which I am acquainted freshmen students must write research papers which involve library research, the accumulation of subject matter, and the compilation of this information into good scientific reports. Often this report can be used not only as an English composition but also as a contribution to a geology class.

At times it is possible to steer students into courses which have a direct bearing upon their major work. Many schools give considerable latitude in the selection of course requirements; for instance, in social science it is sometimes possible for students to take economics to fill a general education requirement. This subject can be a valuable tool for the geologist. An appreciation of economic considerations which govern the policies of the company for which a geologist is working makes him more valuable to that organization. Similarly in the choice of foreign language, the geology faculty can advise a student to take languages which would be of use in his profession.

The attitude of the geology teacher towards general education requirements of the colleges might be summarized in this way:

1. The geology faculty must realize that general education requirements are an integral part of geologic training.

2. We must constantly impress ourselves and our students with the value of these courses for a geologist.

3. The student should be guided into those courses which have the greatest application to his geologic training.

4. Geology majors should be encouraged to use material from geology in assignments for other courses.

5. The geology faculty should educate the faculty in other departments in the needs of the geology student in general education subjects.

6. We should encourage the faculty teaching these required courses by commending them for relating their work to ours.

BOOK REVIEWS

Field Manual for General Geology at Tufts University. Robert L. Nichols. iv and 175 pp. The House of Offset, Boston, Massachusetts, 1956.

Again the teacher has collected in one place for his students a volume of information, this time his notes and sketches of field trips in the Boston Basin. This might be considered a companion volume for *Geologic Diagrams for General Geology* (see this Journal, Vol. 4, No. 1, 1956, pp. 27-28) used by the same students in the same course.

The manual, paperbound in brown cover with blue spine and measuring 8½ by 11 inches, is intended for use in the field and during indoor review sessions. A set of 68 photographs well reproduced on the first 12 pages on glossy paper followed by 4 pages of explanation create the temper of the manual. This reviewer regrets the famous personages in some photographs are not here identified, Alfred Church Lane, a master teacher, for instance, for all to know. Following the practice of two-semester general geology courses with a full afternoon laboratory each week, 5 trips in the Fall and 4 in the Spring happily are possible. Oh, would that more beginning courses in geology be so blessed! The fortunate student who glances ahead to learn what the future holds finds an outline of his trip, usually 3 pages in length, a page or two of definitions to be known by the end of the afternoon, and 8 to 20 pages per trip of field sketches and illustrations, 311 in all, of geologic features soon to be visited. Some sketches are by former students, some from published sources (all duly credited), but most are by the author. A list of features at the side of each sketch are to be identified and placed as labels on the sketches. Occasional pages of poetry or pertinent quotations are appropriately interspersed.

The first of the Fall trips is a walking trip far north of campus, the second and third to the seashore north of Boston by bus, with the fourth and fifth as near-campus walking trips. A review session of these trips next is held indoors. Later the students spend a Winter afternoon in Harvard University Agassiz Museum studying the mineralogic, geologic, and paleontologic exhibits. The 36 sketches of prehistoric animals for the paleontologic part of the trip alone are a remarkable assemblage. One of the Spring trips, all by bus, is north of Boston, the other three being far to the south, the last an exhilarating excursion ending at Nantasket Beach for supper and games at sunset. A final indoor review session of all trips is supported by 7 geologic time charts and 2 geologic columns, 5 maps and 11 cross sections of the Boston area, and 7 beautifully penned physiographic diagrams by Erwin Raisz, drawn for this volume, of the geologic history of Boston Basin.

After a series of such integrated top-notch trips and recapitulations, the reviewer wonders if most students taking this course might not easily be persuaded to major in geology. The course is taught, rather, with a hope that for all, even experiences in general geology will be a pleasure to recall, and this manual then remains a permanent reminder of pleasanter times with a great teacher.

SIDNEY E. WHITE,
The Ohio State University

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APPLIED COURSES WILL LIMIT OUR "PRODUCT'S" POTENTIAL

KEITH M. HUSSEY
Iowa State College

ABSTRACT. It is in the area of the application of our science that we find the greatest lure toward specialization at the undergraduate level. We tend to forget that our students will receive thorough training in the specific application of their geology by whatever company employs them, and so we crowd their curriculum with specialized courses in applied geology. This results in our actually handicapping our "product" in his potential adaptability. We would broaden his horizon considerably if we would allow him time in his undergraduate training for electing work in certain basic courses in engineering, or surveying, for courses in techniques more closely related to geology, and for organization of data into a report.

With the all too short period of time we have for preparing our undergraduate student for either graduate work or commercial work I believe we render him a disservice by limiting his field before he learns what the possibilities are.

My plea is for a broader educational background for our prize product, the undergraduate student; a background that will provide him with a better understanding of the many vocational pursuits available to him in the very broad field of Geology, and thus, allow him to make a wiser, more considered choice of his area of specialization and at the same time provide his eventual employer with a man (or woman) who is possessed of a broad understanding of geology and allied fields, an employee who will be more adaptable, more versatile, more desirable, than any we are now graduating.

Let us reflect a moment on what may be the possible basic causes of this rather puzzling situation; this encouragement of overspecialization at the undergraduate level, which we will all admit, in our off-duty moments, is a bad thing. Within a period of time spanned by only three generations of geologists, Geology has literally exploded from the "naturalist era"—a period in which it was possible for one to learn practically all that was known about geology—to the "specialist era"—wherein it borders on the impossible for one to learn all that is known about even a relatively small subdivision of our now very diverse profession.

I think it may well be that the very speed with which this need for specialization has developed has given those of us who were caught up in the midst of its onrush—those of us who are old enough to have had contact with the "old masters" and young enough to have witnessed the explosive expansion—a feeling akin to panicky frustration in our realization of how little we actually know of what is now known about our crystalline ball, the Earth. In our anxiety to teach our students *more than we know,* we are prone to forget that they will receive thorough training in the specific application of their geology by whatever company employs them and so we crowd their curricula with specialized courses in applied geology in order to make sure that they can assume positions as professional specialists as soon as they receive their diplomas. This short-sighted precaution results in our actually handicapping our "product" in his potential adaptability.

It is in the many relatively young areas of applied geology that we find the greatest lure toward specialization at the undergraduate level. We all know that our students will have to specialize before they can advance very far in their professional careers. However, we would broaden their choice of specialization considerably if we would allow them time for, and encourage their election of basic courses in Engineering such as Descriptive Geometry, Statistics, Surveying, Strength of Materials, or Hydraulics. The basic principles in other fields of Science would be helpful, as well as courses in techniques more closely related to geology, such as interpretation of aerial photographs, preparation of materials to be examined under the microscope, or the organization of field data and the writing of a geological report.

We teach foraminiferal assemblages instead of the principles of micropaleontology; the stratigraphy of a specific area rather than the principles of stratigraphy; specialized subsurface well-logging and mapping techniques rather than the principles of sedimentation.

A hurried survey of college and university catalogues revealed the following, among many, seeming over-specializations at the undergraduate level; as many as six undergraduate courses in paleontology, three undergraduate courses in stratigraphy, the election of a specialized field after the completion of only two semester courses in geology, twelve different varieties of Bachelor of Science Degrees in Geology, thirty-five undergraduate courses in geology.

With the all too short period of time we have for preparing our undergraduate student for either graduate work or commercial work, I believe we render him a disservice by limiting his field before he learns what its possibilities are.

BOOK REVIEWS

Petrographic Modal Analysis: Felix Chayes. xi and 113 pp. John Wiley and Sons, Inc., New York, 1955.

This book fulfills the need for a concise single work to which the serious student of petrography or petrology may turn for information concerning modal analysis. It is not a history of the subject nor is it a panacea for the problems of modal analysis. Its chief virtue is that it defines a path for future study by example.

The first six chapters offer a description of the geometrical basis of the method of modal analysis, which includes a special chapter devoted to the banded rocks; a short review and summary of the techniques and instrumentation, that ranges from the methods of Delesse to the use of the point counter; and a discussion of reproducibility and errors which may produce variance.

The next four chapters present actual modal analyses of three granites. Analytical error is determined, a method for assigning a numerical value to coarseness is described, and the problem of maintaining analytical error at or below a fixed level is solved.

The last chapter is concerned with the limits of modal analysis.

Although statistical argument is used throughout the book, it is surprisingly possible, even for the geologist unfamiliar with statistics, to follow the general theme and to make use of the results of the investigation. For those who want further information on the statistical argument, the author has added an annotated bibliography which lists appropriate references for each chapter.

SAMUEL B. TREVES
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BASIC SCIENCE AND MATHEMATICS REQUIREMENTS IN THE GEOLOGY CURRICULUM

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ABSTRACT. The basic science and mathematics requirements accompanying a major in geology vary greatly depending upon the specific requirements of the colleges, whereas electives in these fields may also vary depending upon the student's field of interest and competence. Considerable variation is found in the Bachelor of Arts vs. Bachelor of Science requirements in different colleges. Although it may be desirable or even necessary for a student to acquire a minor in mathematics and several of the other sciences, the limitation of time within the baccalaureate degree must be considered. A minimum number of hours in each of the fields of mathematics, physics, chemistry and biology should be established as a common requirement for geology students, rather than an emphasis on one or two of these fields to the exclusion of the others.

This report is based on two surveys. First, basic science and mathematics requirements for the B.A. and B.S. degree in geology were tabulated for departments of geology within the United States, as listed in the American Geological Institute's Report Number 11, entitled, "Departments of Geological Science in Educational Institutions of the United States and Canada." Second, the opinions of practicing geologists on basic science and mathematics requirements for the undergraduate geology major were determined by means of a postcard poll.

The departments listed in "Departments of Geological Science in Educational Institutions of the United States and Canada" were divided into three groups, namely: departments in private universities, private colleges, and state supported colleges and universities. For each group, the requirements for the B.A. and B.S. degree were tabulated in the following order: 1) percentage of departments requiring each subject, 2) range of semester hours required in each subject, and 3) average number of hours required in each subject.

As with taxes, happy marriages, and church attendances, statistical studies of degree requirements do not present a true over-all picture. For example, 77% of the schools studied list some mathematics as a specific requirement, but a study of the catalogs of 12 schools without a mathematics requirement shows mathematics to be a hidden requirement for a major in geology in approximately one-half of these schools because one year of mathematics is a pre-requisite for other courses which are required. This observation is applicable to chemistry and to a certain extent, to physics as well. Most colleges, regardless of major, have certain over-all requirements for a degree in any subject matter area and many schools have a field of major requirement. Consequently, even though a course in biology may not be specifically required, many geology majors must take a course in biology to satisfy the school's field of major requirement.

THE CHEMISTRY REQUIREMENT

Chemistry is required more frequently than any other science for an undergraduate degree in geology. It is required by 87% of the schools, whereas only

77% have a mathematics requirement; 74%, a physics requirement; 23%, a biology requirement; 19%, a mechanical drawing or drafting requirement; and 17%, a civil engineering or surveying requirement. Chemistry is required most frequently (97%) by private universities for the B.A. degree and least frequently (83%) by the private colleges for the B.S. degree. For schools listing a chemistry requirement, the average number of hours of chemistry required for the B.A. degree is 8.7 hours, and for the B.S., 9.9 hours.

The poll of 100 practicing geologists revealed that 100% of them took some chemistry in their undergraduate program. 28% of the geologists polled had less than 8 hours of chemistry as undergraduates. 60% of these geologists indicated that more chemistry would be desirable. 53% of the practicing geologists had more than 12 hours, and of these, 65% indicated that if they had it to do over again they would take less chemistry. However, two who had taken more than 16 hours of chemistry indicated they would prefer to have had even more chemistry in their undergraduate program.

The average practicing geologist had 9.9 hours of chemistry in his undergraduate program which is very close to the average chemistry requirement for a B.S. degree in geology at the private colleges.

This study indicates that on the average, chemistry into or through qualitative analysis is probably desirable. This apparently can be achieved in the average situation by a requirement of 10-12 hours of chemistry.

THE MATHEMATICS REQUIREMENT

Seventy-seven percent of the department of geology list a specific mathematics requirement. Mathematics is required most frequently (86%) by private universities for the B.A. degree and private colleges for the B.S. degree, and least frequently (63%) by the private colleges for the B.A. degree. For the schools listing a mathematics requirement, the average number of hours of mathematics required for the B.A. degree is 7.5 hours, and for the B.S., 10.1 hours.

The poll of practicing geologists revealed that 100% took some mathematics in their undergraduate program. 36% of the geologists polled had less than 8 hours of mathematics as undergraduates. 59% of the practicing geologists had more than 12 hours, and of these only 24% indicated they would take less math if they had it to do over again and 12% indicated they would like to have taken more math.

The average practicing geologist had 10.3 hours of mathematics in his undergraduate program which is the same as the average mathematics requirement for a B.S. degree in geology at the private colleges and very close to the B.S. degree requirements at the private universities.

The post-card poll of practicing geologists asked if the calculus is necessary, unnecessary, or desirable for petroleum geologists. 16% replied that calculus is necessary, 30% that calculus is unnecessary and 54% indicated that calculus is desirable. Approximately one-half of the replies which marked calculus as desirable noted on their replies that calculus is desirable mainly as a mental training device. 37% of the polled geologists indicated they had taken calculus and it was

from this group that 40% of the replies were received which indicated that calculus is not necessary. One reply in particular is noteworthy:

"I have been in geophysics for 15 years. I have worked in all phases of geophysical field work and was party chief for 7 years. I am now a division manager. The last time I used calculus was in my junior year in college in my last calculus class."

The results of this study seem to indicate that the increased emphasis upon a calculus requirement, particularly on the part of certain graduate school and personnel managers is unjustified. A calculus requirement does not seem to be justified and in many cases it takes time from other course work which is more desirable for the undergraduate geology major. The study seems to indicate that 8-10 hours of college mathematics is sufficient. In the average case, this will carry the student through analytical geometry and perhaps into beginning calculus.

THE PHYSICS REQUIREMENT

Course work in physics is a requirement for a bachelor's degree in geology at 74% of the colleges and universities in the United States. Physics is required most frequently (89%) by the private colleges for the B.S. degree and least frequently (60%) by the private universities for the B.A. degree. For the schools listing a physics requirement, the average number of hours of physics required for the B.A. degree is 7.6 hours, and for the B.S., 8.8 hours.

The poll of 100 practicing geologists revealed that 87% took some physics in their undergraduate program. 46% of the geologists polled had less than 8 hours of physics as undergraduates. 75% of these geologists indicated that they would take more physics if they had it to do over again. 24% of the polled geologists had more than 12 hours of physics and 80% of these indicated they would advise less physics for an undergraduate program.

The average practicing geologist had 8.4 hours of physics in his undergraduate program which is the same as the average physics requirement for the B.S. degree in geology at the private colleges.

This study indicates that the usual 8-10 hours of introductory college physics is an adequate requirement for the undergraduate major in geology.

THE BIOLOGY REQUIREMENT

Some course work in biology is required for a bachelor's degree in geology at 23% of the colleges and universities in the United States. Biology is required most frequently (40%) by the private universities for the B.A. degree and least frequently (9%) by the State universities for the B.A. degree. For the schools listing a biology requirement, the average number of hours of biology required for the B.A. degree is 5.6 hours, and for the B.S., 5.5 hours.

The poll of practicing geologists revealed that 57% took some biology in their undergraduate program. 75% of the geologists polled had less than 8 hours of biology as undergraduates. Only 16% of these geologists indicated that they would like to have taken more biology. 11% of the polled geologists had more than 12 hours of biology and 15% of these indicated a desire for a better undergraduate background in biology.

The average practicing geologist had 5.6 hours of biology in his undergraduate program which is the same as the average biology requirement for the B.A. degree in the three categories of institutions studied.

This survey reveals that the usual 6-8 hour course in introductory college biology (zoology and/or botany) is an adequate requirement for the undergraduate major in geology.

The Mechanical Drawing Or Drafting Requirement

Course work in mechanical drawing or drafting is required for a bachelor's degree in geology by 19% of the colleges and universities in the United States. Mechanical drawing or drafting is required most frequently (40%) by the state colleges and universities for the B.S. degree and least frequently (10%) by the private universities and state institutions for the B.A. degree. For the schools listing a mechanical drawing or drafting requirement, the average number of hours required for the B.A. degree is 4.2 hours, and for the B.S., 5.9 hours.

The poll of practicing geologists revealed that 61% took some course work in mechanical drawing or drafting in their undergraduate program. 85% of the geologists polled had less than 6 hours of drafting or mechanical drawing as undergraduates. 90% of these geologists indicated that more course work in drafting would be helpful and desirable. The remaining 15% of the geologists who had more than 6 hours of course work in drafting indicated they were satisfied with their undergraduate background in mechanical drawing.

The average practicing geologist had 3.4 hours of drafting in his undergraduate program. 53% of the geologists replying to the poll indicated on their cards that more and better training in drafting and lettering was badly needed by the average practicing geologist.

This study indicated two semesters for a total of 6 hours of course work in drafting or mechanical drawing is probably sufficient for an undergraduate major in geology.

The Surveying Or Civil Engineering Requirement

Course work in surveying or civil engineering is required for a bachelor's degree in geology by 17% of the colleges and universities in the United States. Surveying or civil engineering is required most frequently (22%) by the state universities for the B.A. degree and least frequently (12%) by the private colleges for the B.A. degree in geology. For the schools listing a surveying or civil engineering requirement, the average number of hours required for the B.A. degree is 3.3 hours, and for the B.S., 5.9 hours.

The poll of practicing geologists revealed that 60% took some course work in surveying or civil engineering in their undergraduate program. 79% of the geologists polled had less than 6 hours of surveying. Only 20% of these geologists felt that more formal training in surveying would be helpful. The remaining 21% of the geologists who had more than 6 hours of surveying generally indicated that more than 6 hours of course work in surveying is unnecessary for the average practicing geologist.

The average geologist had 4.5 hours of surveying in his undergraduate program. The results of this survey indicate that two semesters for a total of 6 hours of course work in surveying is probably sufficient for the average undergraduate major in geology.

SUMMARY

This study indicates that for the average undergraduate major in geology, the following basic science requirements are adequate: chemistry, 10-12 hours; mathematics, 8-10 hours; physics, 8-10 hours; biology, 6-8 hours; drafting, 6 hours; and surveying, 6 hours for a total basic science requirement of 44-52 hours which is close to one-third of the total number of hours required by most higher educational institutions for the bachelor's degree.

A total basic science requirement of 44-52 hours is realistic for it permits the undergraduate major in geology to have a balanced curriculum composed of approximately 40-50 hours each of basic science, geology course work, and courses in other areas or disciplines, such as the humanities.

BOOK REVIEWS

Things Maps Don't Tell Us. Armin K. Lobeck. xii and 159 pp. The Macmillan Company, New York, 1956. $4.95.

This little book is not designed as a text-book, nor as a reference for the earth scientist. It is aimed at anyone who has even a little curiosity about the *why* of shapes that he sees on maps. It is a primer of physiographic interpretation.

The book consists of 72 pairs of maps or maps and physiographic or other diagrams. The pairs of drawings are so arranged that a physiographic or geologic problem is posed on the left-hand page and its solution on the right-hand page. The problems cover a wide range (coastlines, 24; islands, 12; rivers, 23; lakes, 12; and cities, 1), but are generally limited to problems of patterns to be found on planimetric maps. This explains the omission of obvious problems such as mountains. Nevertheless, mountains, glaciers, and many other features are introduced in the solutions. Accompanying each problem-picture is a short text that includes a statement of the problem and often also comments on the sketch, some remarks on the geography of the area, or references to similar occurrences elsewhere in the world. The geologic explanation of each problem is revealed by cross-sections, physiographic diagrams, or perspective views, together with a brief text. The texts casually insert much interesting information, related to the examples, that broadens the scope of the book beyond the limits of the problems posed.

A number of geologic terms are introduced in such a way that lay readers will enlarge their earth-science vocabulary quite without realizing it. The diagrams are simple pen and ink sketches skillfully done by Dr. Lobeck. Problems have been chosen from all over the world, but about two-thirds of them are from North America.

Things Maps Don't Tell Us is altogether a charming excursion into earth science that should appeal to the amateur natural historian. It is difficult to judge whether or not this book may be found a useful aid to the formal teaching of physical geography or beginning geomorphology. It lacks sufficient continuity, coherence, and completeness to serve as a text-book. However, it might make a good supplementary reference book, particularly for laboratory instruction in geography or elementary geology. Certainly students and teachers of earth science alike will find this unusual book both interesting and a source of ideas about the teaching of physiographic interpretation from maps.

MALCOLM P. WEISS
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PREPARATION FOR GRADUATE SCHOOL — A STUDY BASED ON THE NEEDS OF GEOPHYSICISTS AND GEOCHEMISTS

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ABSTRACT. Undergraduates planning graduate study in one of the geological sciences need to take a broader range of courses than those seeking a terminal degree. It is important that they have a wide range of science and technology courses in addition to their geology courses so that they can enter any of the geological science specialties without deficiencies. Data are presented on how deficiencies impede graduate study. The results of a questionnaire are summarized, showing what courses are most important for an undergraduate geology major to have taken if he plans graduate work in geophysics or geochemistry.

Undergraduate students major in the geological sciences for a variety of reasons. There are a few who have a deep and well formed interest in geology, and who seek to develop and to expand this interest by formal study. There are others who are attracted because of the published figures on high salaries of geologists compared to other scientists. A large number have talked to friends, relatives, or school advisors, and have chosen geology because they like the idea of field work with its connotation of adventure and exploration. There may even be a few who feel that geology, with its great breadth of scope and attention to the physical world in which we live, is an ideal place to get a truly liberal education.

The undergraduate geological curriculum offered by a university or college must be designed to satisfy the needs of all these students. It must provide a liberal education where this is the student's goal. It must provide specialized training for students who plan professional careers immediately following graduation. It must also supply the basic education on which a graduate program of study can be built. With three such varied objectives, it is not surprising that the programs of different educational institutions differ from one another. Yet most have many features in common. All require a basic minimum of geologic knowledge. The majority of institutions have an elementary course which includes a term or semester of physical geology and another of historical geology. Most also include a required course in mineralogy. Nearly all include one or two courses in geology per semester in junior and senior years. At least one year of college chemistry is usually required, and some college mathematics, at least through analytic geometry and often but not always including differential and integral calculus. An introductory course in physics is sometimes but less often specified.

The nature of the courses required beyond the introductory ones mentioned above varies greatly. The student may be allowed free choice of a certain number of credits from among the offerings of the department, or he may be required to elect one of several options. Almost all curricula include some flexibility in the choice of geological courses as well as those elected in other departments. This

The average geologist had 4.5 hours of surveying in his undergraduate program. The results of this survey indicate that two semesters for a total of 6 hours of course work in surveying is probably sufficient for the average undergraduate major in geology.

SUMMARY

This study indicates that for the average undergraduate major in geology, the following basic science requirements are adequate: chemistry, 10-12 hours; mathematics, 8-10 hours; physics, 8-10 hours; biology, 6-8 hours; drafting, 6 hours; and surveying, 6 hours for a total basic science requirement of 44-52 hours which is close to one-third of the total number of hours required by most higher educational institutions for the bachelor's degree.

A total basic science requirement of 44-52 hours is realistic for it permits the undergraduate major in geology to have a balanced curriculum composed of approximately 40-50 hours each of basic science, geology course work, and courses in other areas or disciplines, such as the humanities.

BOOK REVIEWS

Things Maps Don't Tell Us. Armin K. Lobeck. xii and 159 pp. The Macmillan Company, New York, 1956. $4.95.

This little book is not designed as a text-book, nor as a reference for the earth scientist. It is aimed at anyone who has even a little curiosity about the *why* of shapes that he sees on maps. It is a primer of physiographic interpretation.

The book consists of 72 pairs of maps or maps and physiographic or other diagrams. The pairs of drawings are so arranged that a physiographic or geologic problem is posed on the left-hand page and its solution on the right-hand page. The problems cover a wide range (coastlines, 24; islands, 12; rivers, 23; lakes, 12; and cities, 1), but are generally limited to problems of patterns to be found on planimetric maps. This explains the omission of obvious problems such as mountains. Nevertheless, mountains, glaciers, and many other features are introduced in the solutions. Accompanying each problem-picture is a short text that includes a statement of the problem and often also comments on the sketch, some remarks on the geography of the area, or references to similar occurrences elsewhere in the world. The geologic explanation of each problem is revealed by cross-sections, physiographic diagrams, or perspective views, together with a brief text. The texts casually insert much interesting information, related to the examples, that broadens the scope of the book beyond the limits of the problems posed.

A number of geologic terms are introduced in such a way that lay readers will enlarge their earth-science vocabulary quite without realizing it. The diagrams are simple pen and ink sketches skillfully done by Dr. Lobeck. Problems have been chosen from all over the world, but about two-thirds of them are from North America.

Things Maps Don't Tell Us is altogether a charming excursion into earth science that should appeal to the amateur natural historian. It is difficult to judge whether or not this book may be found a useful aid to the formal teaching of physical geography or beginning geomorphology. It lacks sufficient continuity, coherence, and completeness to serve as a text-book. However, it might make a good supplementary reference book, particularly for laboratory instruction in geography or elementary geology. Certainly students and teachers of earth science alike will find this unusual book both interesting and a source of ideas about the teaching of physiographic interpretation from maps.

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PREPARATION FOR GRADUATE SCHOOL — A STUDY BASED ON THE NEEDS OF GEOPHYSICISTS AND GEOCHEMISTS

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ABSTRACT. Undergraduates planning graduate study in one of the geological sciences need to take a broader range of courses than those seeking a terminal degree. It is important that they have a wide range of science and technology courses in addition to their geology courses so that they can enter any of the geological science specialties without deficiencies. Data are presented on how deficiencies impede graduate study. The results of a questionnaire are summarized, showing what courses are most important for an undergraduate geology major to have taken if he plans graduate work in geophysics or geochemistry.

Undergraduate students major in the geological sciences for a variety of reasons. There are a few who have a deep and well formed interest in geology, and who seek to develop and to expand this interest by formal study. There are others who are attracted because of the published figures on high salaries of geologists compared to other scientists. A large number have talked to friends, relatives, or school advisors, and have chosen geology because they like the idea of field work with its connotation of adventure and exploration. There may even be a few who feel that geology, with its great breadth of scope and attention to the physical world in which we live, is an ideal place to get a truly liberal education.

The undergraduate geological curriculum offered by a university or college must be designed to satisfy the needs of all these students. It must provide a liberal education where this is the student's goal. It must provide specialized training for students who plan professional careers immediately following graduation. It must also supply the basic education on which a graduate program of study can be built. With three such varied objectives, it is not surprising that the programs of different educational institutions differ from one another. Yet most have many features in common. All require a basic minimum of geologic knowledge. The majority of institutions have an elementary course which includes a term or semester of physical geology and another of historical geology. Most also include a required course in mineralogy. Nearly all include one or two courses in geology per semester in junior and senior years. At least one year of college chemistry is usually required, and some college mathematics, at least through analytic geometry and often but not always including differential and integral calculus. An introductory course in physics is sometimes but less often specified.

The nature of the courses required beyond the introductory ones mentioned above varies greatly. The student may be allowed free choice of a certain number of credits from among the offerings of the department, or he may be required to elect one of several options. Almost all curricula include some flexibility in the choice of geological courses as well as those elected in other departments. This

flexibility is a highly desirable thing, especially for students who plan to go on to graduate school. The student preparing himself for professional employment as a geologist immediately following graduation must include many courses in his program which can be deferred until graduate years by the student planning to continue his education. Such postponement has two advantages. First, graduate courses are small and the professor can give each student much individual attention. The subject of the course can be covered more thoroughly, and important concepts can be examined more critically because of the greater maturity of the students and the greater opportunity for student participation in discussion. Second, postponing such courses until later allows the student to take more non-geologic elective courses, both in non-technical subjects and in the other sciences and technologies. The major problem is what subjects should be deferred and what are best completed during undergraduate years.

The breadth of scope of the geological sciences poses a peculiar problem. The professional geologist generally specializes in some branch of the earth sciences. He may become a petroleum geologist, a mining geologist, a mineralogist, or a geomorphologist. Or he may choose one of the border-line fields of geology, such as paleontology, which connects to biology, or geochemistry, which connects to chemistry, or geophysics, which connects to physics. More rarely he may go even farther toward the limits of the geological sciences by choosing hydrology, glaciology, oceanography, meteorology, or even soil mechanics. Each of these specialties requires certain preparation for advanced work, and this preparation differs not only from field to field but from university to university. If, when a student begins graduate work, he has not had the basic courses on which his advanced study is to be built, he will have to take these courses before he begins his graduate work or while he is a graduate student. Students whose preparation is deficient will generally take longer to earn advanced degrees than do those who enter this stage of their studies with the proper background. In rare cases the student may not be able to enter the college of his choice, though most universities will take a good student no matter how deficient his background is.

In order to illustrate how greatly lack of the prerequisites to graduate studies may handicap a man, I examined the records of 32 students admitted to the Graduate School of The Pennsylvania State University as majors in geophysics and geochemistry during a seven year period. All of these men have either been admitted to candidacy for the Ph.D. degree or have earned the M.S. degree. Their undergraduate majors ranged from geology and mineralogy to such diverse fields as engineering, chemistry, mathematics and physics. Sixteen of them had deficiencies of three to 12 credits on admission. The average deficiency of the sixteen was 6⅔ credits. The rest had no formal deficiencies on admission. For those admitted without deficiencies the average time from the start of graduate study to the achievement of the M.S. degree or Ph.D candidacy was 20.4 months. This time is strongly influenced by the fact that all except one of these students held either a part-time or a full-time job during all or part of his period of study. Seven of these students had completed what might be considered to be the first year of graduate work in not over 18 months and eleven of them had reached this point in two years.

The situation is very different for the sixteen students who had deficiencies on admission. Their average time to the M.S. degree or Ph.D. candidacy was 22.6 months. Only two of these students were able to complete one year's work in a year and a half. Regardless of the size of the deficiency most of them took nearly two years. One reason for this is that even though a student has a small deficiency or even no deficiency on admission, if his background is weak in some area important to his graduate specialty, he will be expected to take more than the minimum number of courses to earn his degree. He may even find that he has to pick up on his own, outside of classes, a great many of the techniques and concepts which are essential for his advanced course work and for his research. Even though the students with deficiencies took on the average only 2.2 months more than students without deficiencies, in almost all cases their educational advancement was delayed.

Although I have no statistics for some of the other effects of deficiencies on entering graduate school, from my own experience talking to individuals I am convinced that such deficiencies not only increase the time of graduate work, but make graduate training less effective. The student with an incomplete background tends to hold back the other students in his classes even where he has the minimum prerequisites. He may develop a sense of inferiority and frustration which prevents him from doing his best work. Inadequacies in undergraduate training may so discourage a man that he loses his incentive to do superior work, and he may either leave the geological profession entirely or shift to a branch which is not his first choice.

Realizing, then, the importance of giving the student the proper background for graduate work while he is still an undergraduate, we may ask ourselves why it is that so many students enter graduate school without the proper preparation. I think the most obvious reason for this is that the students themselves do not know what specialty they wish to enter until late in their undergraduate careers. It is here that the importance of faculty advising as to electives is of the greatest importance. The wise advisor will see to it that his better students take a broad foundation of courses both in geology and the other sciences so that the widest possible choice of specialities will be open to his men.

My own interest in this problem arises from the fact that I have seen so many young people enter my own Department of Geophysics and Geochemistry at Penn State with big deficiencies. I have seen others lose their interest in a graduate career in these specialties when they found out how ill-prepared they were to enter graduate school. In order to find out what other universities expect of their incoming students, I wrote to friends and acquaintances in 18 leading American universities where advanced degrees are given in either geophysics or geochemistry, and asked what they expected of incoming students. I received answers from fifteen schools which give degrees in geophysics and eight which give degrees in geochemistry. I am happy to say that almost everyone answered.

My first two questions were: (1) "Are there any courses which you consider absolutely essential as prerequisites to graduate work in geophysics (geochemistry) so that unless a student has had these courses, no matter how good he

looks in other respects, you will not admit him as a graduate student"; and (2) "Is there any limit to the size of course-work deficiency which a student may have and still be admitted to graduate work at your institution provided he makes up this deficiency simultaneously with his graduate studies?"

It is clear from the comments which I received that the majority of universities will take any student provided his undergraduate record is good. A few required some mathematics, physics, chemistry or geology or a combination of these. One school would take a student only if he had an undergraduate major in physics or geology, another only if he had an undergraduate degree in mathematics or physics. One required a certain minimum number of courses from a list. Most institutions have no limit to the amount of deficiency which a student could have before he would be admitted. Three said 15 to 16 credits, about the equivalent of one semester. My own experience shows that students are almost never this deficient in the minimum admission requirements.

The third question I asked concerned specific courses, and read as follows, "Please check in the first column those among the following courses which are prerequisite to courses in geochemistry in your institution which beginning graduate students commonly take. Check in the second column those additional courses which you feel should be taken if convenient by undergraduate geology majors contemplating graduate work in geochemistry. Add any additional courses which you and your colleagues feel belong on the list." The circulated list included General introductory geology, general introductory chemistry, physical chemistry, differential and integral calculus, general introductory mineralogy, petrology, general introductory physics, quantitative analysis, historical geology, structural geology, use of the petrographic microscope, economic geology, and mathematical statistics. When I asked Question 3 I had expected everybody to check either the "Prerequisite" or the "Also Recommended" column or neither. However, quite a number of answerers checked both the "Prerequisite" and the "Also Recommended" column. I had supposed that any course which was a prerequisite to a popular course would also be recommended. Perhaps some people feel that this is not necessarily the case. In tabulating the results when both columns were checked I counted it only as a check in the prerequisite column. It is clear that for geochemistry the four most important courses are general geology, general chemistry, physical chemistry, and calculus. These are prerequisite to graduate courses in three quarters of the universities reporting, and are recommended by the others. Introductory mineralogy and petrology are also recommended by all the institutions answering the questionnaire, though they are not so often prerequisites to graduate courses. The other important courses are general physics, quantitative analysis, historical geology, structural geology and use of the petrographic microscope. Economic geology and statistics were considered less essential but were recommended by some. Three other courses were written in on the circulated list, each by at least one person: thermodynamics, atomic or nuclear physics, and differential equations.

Introductory chemistry, geology, and mineralogy, historical geology and petrology will almost always be taken by undergraduate geology majors. Petrography will often be taken but not always. However, my personal experience indicates that a

great many students do not take calculus. This course, which is considered highly important by all the geochemists, is not offered for graduate credit at most institutions. Physical chemistry, also commonly missed by geologists, is equally important. Quantitative analysis and introductory physics are commonly taken. The importance placed on structural geology as compared to other advanced geology courses is worthy of note. This course is often deferred until graduate years for conventional geology majors. Notable by their absence are courses such as field geology, dear to the hearts of most geologists.

The tabulation for geophysics shows a similar breadth of necessary background. Only one course was listed by all fifteen responders: calculus. General physics, general chemistry and structural geology were recommended by all except one. General physics was the most commonly listed prerequisite course. Nearly as important were general geology, electricity and magnetism, and differential equations. The last two of these are courses which few geology majors take. Yet in the majority of the schools covered both are prerequisite to courses commonly taken by first year geophysics graduate students. The omission of general geology by one school may have been an oversight, as the same school listed structural geology as prerequisite to some geophysics courses. Three other courses were listed in over 50% of the answers, historical geology, electronics, and geophysical prospecting. Historical geology is the only one regularly taken by geologists. It is interesting to note that only one-third of the institutions have geophysics courses as prerequisites to courses taken by first year graduate students. However, two-thirds of the schools think that it is desirable that a student have had at least one geophysics course before going to graduate school. The importance of electricity and magnetism and electronics to geophysics is shown by the frequency of their recommendation. Two other geology courses, economic geology and petroleum geology, were recommended for geophysics majors, but by less than half of the schools. No geology course was added in the write-in section although mathematics, physics, chemistry, engineering and astronomy courses were added.

One thing can clearly be concluded from this study. Geology should not be overemphasized in the undergraduate curriculum of a student planning graduate work. It is vitally important that such students get an equally thorough background in mathematics, physics and chemistry. The student going on to graduate school should give approximately equal emphasis to each of the physical sciences, and perhaps biology as well, since some students will wish to become paleontologists. Mathematics is particularly critical, as experience has shown that here is where students are most often deficient, and where the deficiency is most restrictive. Because courses in geophysics and geochemistry are so often postponed until graduate years, many undergraduates get the impression that mathematics is not important in geology. This is simply not the case. It is essential for geophysics and geochemistry; and in the author's opinion geophysics and geochemistry are just as essential to the programs of every geologist as is petrology or paleontology or any other advanced geology course. Lack of sufficient mathematics will prevent students from taking geophysics and geochemistry, and it will discourage students from going on to graduate work in these subjects. If we let students get through undergraduate years without sufficient mathematics or without any

advanced physics or advanced chemistry in addition to their geology, we are cutting them off from some of the most exciting and rapidly developing areas in geology today.

This report has been presented primarily from the point of view of the geochemist and geophysicist because these are the fields most familiar to the author. Other men might stress the importance of other courses, but certainly it must be clear that to provide the superior student with the greatest opportunity to develop his talents, what is necessary is the broadest possible foundation of preparation in all the sciences during undergraduate years, and a minimum of concentration on purely geological courses. Lest my fellow geologists feel I am picking on their specialties, let me add that a similar comment applies to most science curricula, including physics and chemistry, which tend to be undesirably weak in geology.

ACKNOWLEDGMENTS

The author wishes to thank the following for the data on which this study is based: Harrison Brown of Cal. Tech., Perry Byerly of Univ. of Calif., Kenneth L. Cook of Utah, Peter Dehlinger of Texas A. and M., Maurice Ewing of Columbia, Samuel Goldich of Minnesota, Beno Gutenberg of Cal. Tech., Heinrich D. Holland of Princeton, John C. Hollister of Colorado School of Mines, Patrick M. Hurley of M. I. T., J. Lawrence Kulp of Columbia, L. Don Leet of Harvard, Harold Mooney of Minnesota, Charles F. Park, Jr. of Stanford, Louis B. Slichter of U. C. L. A., Marvin H. Wilkening of New Mexico Inst. of Mining and Technology, James T. Wilson of Michigan, J. Tuzo Wilson of Toronto, and George P. Woollard of Wisconsin. Without the kind cooperation of these men this study would have been impossible.

Contribution No. 56-25
Mineral Industries Experiment Station
The Pennsylvania State University

TABLE 1

Q1. Are there any courses which you consider absolutely essential as prerequisites to graduate work in geophysics (geochemistry) so that unless a student has had these courses, no matter how good he looks in other respects, you will not admit him as a graduate student? If so, please list these courses here:

Course	*Geochemistry*	*Geophysics*
None	3=50%	9=60%
Degree in physics or geology	..	1= 7%
Degree in math. or physics	..	1= 7%
Some math., physics, chemistry	3=50%	3=20%
Other	..	1= 7%

Q2. Is there any limit to the size of the course-work deficiency which a student may have and still be admitted to graduate work at your institution provided he makes up this deficiency simultaneously with his graduate studies? If so please state the limit in semester hours or equivalent units:

Limit	*Geochemistry*	*Geophysics*
None	7=100%	10=77%
15 or 16	..	3=23%

TABLE 2

COURSES IMPORTANT FOR GEOCHEMISTS

Q3. Please check in the first column those among the following courses which are prerequisite to courses in geochemistry in your institution which beginning graduate students commonly take. Check in the second column those additional courses which you feel should be taken if convenient by undergraduate geology majors contemplating graduate work in geochemistry. Add any additional courses which you and your colleagues feel belong on the list:

Course	Prerequisite to geochemistry courses taken by 1st year graduate students	Also recommended for geology students planning graduate work in geochemistry	Listed by
General introductory geology	6	2	100%
General introductory chemistry	6	2	100%
Physical chemistry	6	2	100%
Differential and integral calculus	6	2	100%
General introductory mineralogy	3	5	100%
Petrology	2	6	100%
General introductory physics	3	4	88%
Quantitative analysis	3	4	88%
Historical geology	1	6	88%
Structural geology	1	6	88%
Use of the petrographic microscope	1	5	75%
Economic geology	1	3	50%
Mathematical statistics	0	3	38%
The following courses were write-in answers:			
Thermodynamics	0	3	38%
Atomic or nuclear physics	1	1	25%
Differential equations	0	1	13%

TABLE 3

COURSES IMPORTANT FOR GEOPHYSICISTS

Q3. Please check in the first column those among the following courses which are prerequisite to courses in geophysics in your institution which beginning graduate students commonly take. Check in the second column those additional courses which you feel should be taken if convenient by undergraduate geology majors contemplating graduate work in geophysics. Add any additional courses which you and your colleagues feel belong on the list:

Courses	Prerequisite to geophysics courses taken by 1st year graduate students	Also recommended for geology students planning graduate work in geophysics	Listed by
Differential and integral calculus	11	4	100%
General introductory physics	12	2	93%
General introductory chemistry	7	7	93%
Structural geology	7	7	93%
General introductory geology	10	3	87%
Differential equations	10	3	87%
Electricity and magnetism	8	5	87%
General introductory mineralogy	6	6	80%
Historical geology	8	3	73%
Electronics	4	7	73%
Geophysical prospecting	5	5	67%
Economic geology	1	6	47%
Petroleum geology	1	6	47%
The following courses were write-in answers:			
Mechanics or statistical mechanics	1	2	20%
Mathematical or theoretical physics	1	2	20%
Statistics or numerical analysis	1	1	13%
Thermodynamics	0	2	13%
Physical chemistry	1	0	7%
Electric circuits	1	0	7%
Astronomy	1	0	7%
Wave mathematics	0	1	7%
Nuclear physics	0	1	7%

ERRATUM NOTE: Vol. 4, No. 2, Part 2, p. 68, line 26, should read: technique or a science." Even worse is the fact that all those thousands of mineral-

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LANGUAGE REQUIREMENTS AND OTHER REGULATIONS FOR GRADUATE STUDY IN GEOLOGY

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ABSTRACT. Analysis of replies from 92 institutions granting degrees in geology shows wide variance in graduate requirements. Large departments and those offering both a master's and a Ph.D. tend to relax thesis and examination requirements at the master's level. Larger departments and Middlewestern institutions tend to permit substitution of other languages for French and German or to substitute some other qualification for one of the languages customarily offered for the Ph.D. degree.

The purpose and character of the requirements for advanced degrees present a continuing problem to undergraduate as well as graduate faculties. Undergraduate students must be prepared for language examinations, entrance examinations, and for advanced study in general geology and minor subjects as well as in their special field of geology. Specific graduate requirements vary from school to school and change more or less continuously. Thus undergraduate advisers often lack concrete information to support their recommendations, which is inconvenient in the face of the usual recalcitrant sophomore wishing to study nothing other than oil geology. A compilation of current practices in the graduate schools is, therefore, of interest to undergraduate faculties.

Graduate faculties, on the other hand, are frequently asked to consider revision of graduate regulations. Information about what others are doing is useful when considering proposed changes. This writer, however, would be the last to suggest that general usage should be the most important argument for or against a policy. Each faculty should create and maintain regulations suitable to their own student body and educational objectives. No single set of requirements may be considered "better," except as applied in specific situations.

The data presented here were gathered to aid our department in considering proposed changes in language requirements. Inasmuch as catalogues often do not contain departmental rules or present "customary action," questionnaires were sent to obtain the *de facto* regulations in all departments of geology in North America listing more than three full time staff members in the AGI Directory. A total of 92 replies were received from departments granting advanced degrees as well as about 20 from departments without graduate instruction. For purpose of analysis departments were grouped as Canadian, Northeastern, Southcentral, Northcentral, Southeastern, Northwestern or Southwestern. Departments were also grouped by number of graduate students and according to degrees granted. All data were recorded in terms of existing conditions rather than as written in the catalogue. For example: If a department stated that it effectively discouraged students from presenting Spanish for the language requirement, Spanish was not considered acceptable even though formal regulations permitted its use. Also

* A contribution from the Museum of Paleontology, University of California, Berkeley, California.

departments were listed as giving a degree only if they had candidates enrolled for the degree. Pertinent regulations were tabulated, however, even if no candidates were present. Thus our conclusions reflect operating conditions at the time the questionnaires were answered in late 1955 and early 1956.

It is, perhaps, most interesting to note that although 40 of the 92 departments do not require a language for the master's degree, all but 11 require two languages for the Ph.D. This suggests that it is essential for any student contemplating a doctoral program to devote serious effort to language study while still an undergraduate. A student not expecting to continue beyond a master's degree could possibly dispense with such preparation, but would certainly be handicapped if he changed plans or entered one of the schools which require language proficiency for the master's degree. Geographic analysis shows that Northeastern schools are much stricter in requiring languages for master's candidates. Canadian, Southeastern and Southwestern departments follow in that order. More than half the departments offering only the advanced degrees maintain the requirement at the master's level. As would be expected from these figures, the schools with fewer than five graduate students show a slight preponderance of those requiring languages, but, interestingly enough, almost half of those with more than 50 graduate students also require a language examination for master's candidates.

Only 13 departments insist on French or German for the master's and both for the Ph.D. Eighteen accept German and an additional language for the Ph.D., and 13 will accept French with an additional tongue. Russian is accepted as a second language by 47 schools and Spanish by 43, but only 24 faculties will accept languages other than German, French, Spanish or Russian. These figures demonstrate that the traditional requirement of French and/or German is by no means universally maintained, but that no undergraduate student can afford to avoid the study of German if he is uncertain where he will enter graduate study. A recent innovation has been the introduction of substitute qualifications for one of the two languages required for the Ph.D. Eleven departments have accepted additional minor subject study, additional course work in the major or minor, or proficiency in some designated field such as statistics in place of the second language. No school, however, has entirely dispensed with language requirements for the Ph.D.

Geographic analysis again shows Northeastern schools hold a more rigid or conservative attitude in requiring French or German for the master's and both for the Ph.D. These schools are also more likely to reject alternatives for the second language, and few of them accept the relatively "easy" Spanish language. Canadian schools share this attitude but elsewhere a generally more liberal attitude prevails. The Northcentral schools are most lax. One third of all schools offering only the master's degree require French or German and half of those offering both degrees require German. Only one-fifth of the schools offering a Ph.D., however, require both French and German. These figures emphasize the continuing importance of German in the undergraduate geology curriculum. The language is always acceptable to a graduate school and is often essential, especially at the doctoral level.

Small departments and those with more than 50 students again more strictly enforce the traditional language requirements while those of medium size are more liberal.

Except for preliminary and final examinations for the Ph.D. degree, there is little uniformity in various other requirements for advanced degrees. Slightly more than ⅓ of the respondents screen entering graduate students by examination and relatively few of these mentioned the graduate record examination. On a regional basis, Southeastern, Southwestern and Northwestern schools give entrance examinations more generally while Canadian schools place least emphasis on examinations. Almost half of the schools offering only the master's degree give entrance examinations, but the proportion falls to little more than ⅖ among those granting the Ph.D. degree. Schools of moderate graduate enrollments (6-25) were most prone to employ entrance examinations.

Preliminary and final examination of master's candidates is less widespread than for doctoral students. Preliminary examinations are given in half of the schools offering a master's only and in two-fifths of the schools offering both degrees. This requirement is similar to an entrance examination and many schools not requiring an entrance examination do require a master's preliminary examination. The latter, however, is usually given after fulfillment of the language requirement and is, therefore, not strictly comparable to a graduate entrance examination. Approximately twice as many departments require the final examination as the preliminary, but only one-third require both. In general, smaller schools are more rigid in this requirement, but the difference is not great. As before, Canadian schools are less likely to give examinations, but there seems to be little geographic variation in attitude toward master's preliminary and final examinations in the United States.

The traditional publication requirement for the Ph.D. has been abandoned by all but 10 respondents, but all of them still require a thesis. At the master's level a thesis is required by 39 of 40 departments offering this degree only. Only 38 of the 52 departments offering the doctorate, however, insist upon a thesis for the master's degree. Permissible substitutes include extra course work, added minor subjects, or a series of extra "research" papers submitted in graduate courses. Some schools, however, have dispensed with the requirement without adding a substitute. All Canadian schools require a master's thesis and smaller departments tend to require a thesis. Our Northeastern schools and those with relatively large departments are most likely to permit substitution for or elimination of master's theses.

About half of the schools in the United States limit the total number of research credits which may be applied toward graduate course requirements. This is in marked contrast to the almost complete lack of such limitations in Canada. Minor requirements and course distribution requirements within the geology department were cited by between one-third and one-half of the respondents in almost all categories. These figures are probably deceptive, however, because many departments combat excessive specialization by very informal means. For example, the major professor may be relied upon to broaden the program of his students on an individual basis and by personal "negotiation."

In summary it seems apparent that smaller departments tend to be more strict in requiring the traditional program for graduate work. Furthermore this is even more marked in schools offering only the master's degree. This is partially explained by a widely held attitude that time spent on a master's degree is wasted when a student continues to a doctorate. Another factor is the much larger burden of graduate supervision in departments having large enrollments. Many staffs would spend more than half of their time merely reading theses if they were required of all master's candidates. It is also perhaps true that any department's major effort is devoted to its most advanced students. There are probably additional reasons for the relative conservatism of smaller departments, but it does seem obvious that a master's candidate is likely to receive more attention and, presumably, better training in one of the smaller institutions. If, on the other hand, a student is certain that he wishes to acquire a Ph.D., he may be able to save time, at the expense of experience, by attending a larger institution with fewer formal requirements.

Finally it must be emphasized that all of the conclusions presented in this discussion are generalizations. Many schools do not follow the pattern of the groups to which they belong.

TREASURER'S REPORT: CONDENSED FINANCIAL STATEMENT

January 24, 1956, to January 24, 1957

Balance Brought forward, January 24, 1956		$ 533.42
Income, January 24, 1956, to January 24, 1957		
Journal of Geological Education sales (current and back issues)	$ 430.20	
Journal reprints sales, Vol. 4, Nos. 1 and 2	215.40	
National dues (current and back payments)	806.50	
Total income	$1452.10	$1452.10
Total credits, as of January 24, 1957		$1985.52
Expenditures, January 24, 1956, to January 24, 1957		
Journal of Geological Education: printing, envelopes, mailing	$1031.10	
Authors' reprints, *Journal,* Vol. 4, Nos. 1 and 2	228.29	
Officers' expenses	57.06	
Neil Miner Award, 1956, scroll	6.73	
Northwest Section dues forwarded	3.00	
Total disbursements	$1326.18	$1326.18
Balance on hand, January 24, 1957		$ 659.34

Respectfully submitted,

C. G. HIGGINS, 1955-1956, *Treasurer,*
Association of Geology Teachers.

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THE PROBLEM OF FOREIGN LANGUAGE REFERENCES IN A SEMINAR ON ROCK MAGNETISM

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State College of Washington

ABSTRACT. Some answers are offered to the commonest arguments against the continuance of foreign-language tests for geology graduate students. By way of illustration, a graduate seminar of 1955 in rock magnetism and paleoclimates is described, in which a significant proportion of pertinent foreign literature was either disregarded by the students or had to be translated for them. Some suggestions are offered for making the language requirement more palatable and usable.

Those of us who direct graduate work in geology are frequently called upon to take sides in or to referee the battle of the required foreign language. It is difficult to convince an advanced-degree candidate that a reading examination of French and German—let alone Russian, Japanese, or even a language of intermediate difficulty—is anything more than an obsolescent ritual penance imposed upon him by the Graduate School.

It is well to question the language requirement and ask whether it is outmoded or at least of subordinate value. It is well also that those who question its usefulness be made aware of just how useful it is, and not merely how difficult a foreign language is to learn when one has scarcely mastered his own. This paper will probably not change anybody's convictions; but it may have some value in drawing out a reasoned opposition. Rightly or wrongly, the discussion below will consider only the usefulness of the language in research, and not the social graces, the advantages to residents abroad, or the improvements to one's speech which it imparts.

The usual argument advanced by an advisor—namely, that a language will enable a student to explore the new ideas in his own research field as they are published abroad—leaves him unmoved, since he believes that (1) he has more than a lifetime of reading within his field in the English language alone; (2) that presently the new ideas from abroad will be translated into English; (3) that in an emergency he can employ a professional translator; and, most urgently (4) he is snowed under with course and thesis work anyway.

He is, of course, quite right in much of his argument for using only the English language, for:

(1) He can spend his life reading in English about his specialty, if he is willing occasionally to forego a valuable foreign article in favor of a number of insignificant ones in English; that is, to read in English everything written in his field without discrimination.

(2) He can wait for published translations to appear, secure in the knowledge that the best will be translated first, if he does not mind taking the risk of being out of date for a few years or of following a line of research already adequately investigated and described.

(3) He can generally locate a translator, although prices are high and work is slow, and consequently it is usually easier just to forget about it. Fortunate ones may have a cooperative colleague willing to do jobs of translation, but this can hardly be counted on.

(4) He has plenty to do in course assignments and assisting in laboratories, without studying for a language exam. Though he should have been guided into starting a foreign language as an undergraduate or earlier, he was not; and now he is up against it, and would like to change the rules. He is generally the one who has the most convincing arguments that a foreign language is superfluous these days, and it is to him and about him that I write, using as illustration the struggles of a graduate geology seminar on rock magnetism held the fall semester of 1955 at the State College of Washington.

The seminar consisted of three students: one in stratigraphy and two in mineral deposits. During the first half of the semester, the four of us prepared and discussed a bibliography of articles reporting facts and concepts explaining why some rocks have normal residual magnetic fields, and others have reversed fields. Since one hypothesis explains the difference as due to a difference in composition and cooling history of the ferromagnetic minerals of the rock, and the other hypothesis requires the entire geomagnetic field to reverse itself periodically, the search for references was an extensive one.

It was soon apparent that although there were many excellent works in English, by American, English, and Japanese authors, there were also many in German and French. The instructor reported on these foreign language works, since time was short; and although two of the students had passed their official language examinations, it was plain that they had no desire, or perhaps intention, of using their new technique. The wife of one student was ready, he reported, to assist him in translating any articles that he might be required to review. A less tiresome instructor might have let the articles in English suffice for this survey, but in this way nobody would have heard of the pertinent works of Ramdohr, Lindley, and others on the recognition of the many black opaques that pass for magnetite; nor would the whole cortège of short articles, since Melloni's first notice of a century ago, by Folgheraiter, Thellier, Chevallier, Roche, and several others, concerning the magnetization of lavas and baked clays, have come to light; nor even the excellent summaries by Haalck and Thellier, written before battle lines were drawn clearly.

It was in the second half of the semester, however, that our progress was most hampered by incompleteness of coverage of the pertinent foreign literature. Our objective was to draw comparisons between the path of the earth's polar wandering, as derived from paleomagnetic data, and the same, as derived from paleoclimatic data. For ready comparison, both sets of data were to be plotted on stereograms having the present N. and S. poles of the earth at top and bottom of the stereo circles, whose vertical diameter was the 180° meridian. An annotated bibliography was to accompany the stereograms, and everyone was to finish up the course with a copy of everything. These steps were followed; the reports and stereograms were duly submitted and distributed, and grades were given.

Neither the class nor the instructor expected to find entire agreement between the paths of the North Pole derived by the two unrelated methods, but we were not prepared for the almost malevolent tendency of the two solutions to differ as widely as possible. We soon recognized that we had more usable data from the very recent geomagnetic studies than from stratigraphic and geotectonic literature, contrary to expectation. The calculated pole positions derived from geomagnetic studies were already published, primarily by Clegg, *et al,* (1954), Graham (1949 and 1955), Hospers (1955), and Runcorn (1955), and thus were easy to adapt.

At first, the instructor—a petrologist—and perhaps the seminar, naively believed that the paleoclimatic data for the world as a whole could be derived without too much trouble: Paleogeographic maps could be combined with data on the distribution of fossils of marine invertebrates known to have inhabited only warm water. Thus would appear the locations of the tropical zones of the geologic past from which the poles could be inferred approximately, and perhaps also the positions of past warm currents such as the Gulf Stream of today. (The locations of deserts and glaciated areas of the past, though interesting, were not considered reliable indicators of pole or equator positions, and we did not think of using the directions of dune foresets to indicate paleo-tradewinds as a Coriolis effect.) Schuchert's paleogeographic maps of North America (1955) and the Termiers' Histoire Géologique de la Biosphère (1952) came to mind; and we believed that three or four such works would provide most of our paleoclimatic data. Fortunately Chaney (1940) had already indicated, from the evidence of paleobotany, that the North Pole must have remained fairly constant since the Eocene.

We were disillusioned very soon. The Termiers had done for the world what Schuchert had done for North America; but their book, being in French, was slow reading: too slow for the class to extract all of the data it might contain on paleoclimates. Also, time was running out, and we could not undertake to scan those articles in the abstract journals whose titles suggested that they might contain paleoclimatic data of use to us. These titles were simply passed over. Had the articles been in English, probably there would have been time to review them. Moreover, a number of them were in journals that would have to be borrowed from the University of California or even farther. Still, we could have begun with those on hand, and no time would have been wasted in waiting. We would have had our hands full enough: a thorough search in any abstract journal is slow, unless one can translate a French or German title almost as fast as a title in English. None of the seminar had quite this facility in translation, and so the later data on paleoclimates remained buried.

Fortunately, Hospers (1955) (a Dutchman) had summarized (in English) some early views (in German) on the positions of the North Pole in past times, and his report was made to fill in the voids in our pre-Tertiary information. He presented in useful form the conclusions of Kreichgauer (1903), Köppen and Wegener (1924), Milankovitch (1934), and Köppen (1940); but we had no way of testing the reliability of their conclusions, since we made no effort to obtain their original works.

The seminar also seized upon one other work in the English language—that

of the Chinese, T. Y. H. Ma (1951-1952)—whose maps, derived from paleoclimatic studies, were drawn to illustrate continental drift. Rather cautious use was made of these maps, since it was at times difficult to ascertain whether the pole positions were placed with respect to the drifting continents of the time, or to the present configuration.

The stereograms made by the class will not be reproduced here, since a suitable generalization of their point-groupings does not differ essentially from published plots of polar wandering (Hospers, 1955, p. 67).

It must be emphasized again that the information gained by the seminar from paleoclimatic data is far from complete and shows little deviation from Köppen's generalizations of 1940. It may be noted also, that N. D. Opdyke, an American graduate student at the Newcastle branch of Durham University, subsequently made these same comparisons and reported on them at the XXth International Geological Congress (Opdyke, 1956). He found fair agreement between magnetic and climatic poles for the southern hemisphere but emphasized the need for more work. Also E. Irving (1956) found general agreement between climatic and geomagnetic poles.

In summary, the seminar on rock magnetism, like other seminars, may be considered a pilot operation whose function is to give its members some practice in scanning the literature of their field, prior to undertaking a research project. In this instance, a balanced survey was achieved only by the inclusion, along with the articles in English, of many articles in German and French, reported by the instructor.

The rapidly expanding study of rock magnetism, with its geotectonic implications, is not the only one requiring some facility in the use of one or more foreign languages. The study of a geologic subject in the literature of only one country leads to insularity and inbreeding of ideas when presumably one is seeking the truth. American geologists are numerous and competent, and the conflicts of their ideas generally get us ahead; but to get us farther, this conflict must continue to include foreign geologists, writing in foreign languages. In the long view, the extra effort of learning to translate one or more foreign languages, even during two postgraduate years, is many times repaid during the 40 subsequent years of productive research.

As remedies for the existing deadlock between graduate students and their language requirement, three suggestions are offered below, in order of decreasing idealism and increasing applicability.

As many have said, the time to learn a foreign language is in early childhood, or even as late as grade school. This is impractical for us, since for best effect it requires playmates who speak a foreign language. It must therefore apply only to diplomats' families, those on Technical Assistance programs, and others able to spend years abroad. For all others, classroom learning afterward is never so good and "rapidly gets no better" through the high school and college years, when the student sees no sense in learning a language and becomes stubborn about it.

Probably this situation will not soon change. Therefore, teachers of foreign

languages, with as much cooperation from ourselves as they can get, will have to try to revive for their students the nearly forgotten fact that learning for its own sake is the one pleasure that does not pall with continued experience. The learning and using of a foreign language falls in this category, and a person who has become infected with the virus of learning would rather do this than eat. (This is not uncommonly the alternative that has actually existed—the present era, of course, excepted.) The task of a language teacher in high school or college is therefore obvious but nearly impossible: to create in his students a starvation for knowledge about the country studied and its language. This proposal does not aim quite so far into the future as the first one and is probably being attempted and achieved on a small scale.

The final proposal is dull by comparison, but workable—if anything can be regarded as workable which lacks the sanction of the appropriate Deans. Require only one foreign language of a Ph.D. candidate, but require an easy proficiency far beyond the stumbling translations which are now accepted, out of charity, by the examiners. Composition and conversation would be added, with the objective of improving the student's rate of reading. One language this well learned is worth much more than the two learned under the present minimum conditions but takes no more time. Candidates for Master's degrees, being less apt to use foreign literature extensively than Ph.D. candidates, could do with only a reading examination in one language, as some departments now require.

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BOOK REVIEWS

Theophrastus on Stones. Earle R. Caley and John F. C. Richards. vii and 238 pp. The Ohio State University, Graduate School Monographs, Contrib. in Phys. Sci., No. 1, 1956. $6.00.

Geology teachers know that the beginnings of geologic thought go back into Antiquity even though the development of the science as a separate discipline is not more than three centuries old. Adams' *Birth and Development of the Geological Sciences* (1938) has given us fascinating glimpses into the geologic thinking of the Greeks and Romans. He has shown us that many of the cardinal principles of geology were known to the ancients who, in some respects, were more advanced than their successors of the early Renaissance. Once curiosity is aroused concerning this subject, there is a natural desire to read at first hand just what the Greeks knew about geology. Satisfaction of this desire is not easy. Translations exist but they are not easily accessible.

One of the most important, frequently quoted authors of Antiquity is Theophrastus of Lesbos (*circa* 372-322 B. C.). His geologic work is contained in a small book, really equivalent to a chapter of a modern book, entitled "On Stones." It had been translated into English by John Hill in the eighteenth century and into Latin, French, and German by others. Hill's translation is rare and its commentaries are out of date. What was needed was a new translation with commentaries in line with the present state of the geologic sciences. The happy collaboration of professors Caley and Richards has resulted in a more accurate translation and far better commentaries that explain Theophrastus' thought clearly and exactly.

The translators are especially well fitted for their task. Professor Caley is a chemist of high professional standing and fine reputation as a teacher. He has long been interested in the applications of chemistry to classical archeology and has made many contributions in that field. He has taught chemistry at Princeton and is now on the faculty of the Department of Chemistry at the Ohio State University. Professor Richards is widely known as a classical scholar and has taught in that field at various universities. He is at present on the faculty of the Department of Classics at Columbia University.

The result of their collaboration is a fine example of orderly scholarship, pleasing both to the specialist and to the layman. The authors first give the Greek text, indicating variants in the known manuscripts, missing words, and their probable nature. Because of the arrangement of the footnotes and commentary, the book can be read continuously and the reader scarcely need be aware of the uncertainties and interpretations that had to be solved to produce the text.

The Graduate School of the Ohio State University is to be congratulated for sponsoring this publication and for sparing no effort to ensure good, clear printing and pleasing appearance to this volume. It is an example of fine printing as well as of scholarly achievement.

AURELE LA ROCQUE
The Ohio State University

TRANSACTIONS
OF THE
ASSOCIATION OF GEOLOGY TEACHERS

REPORT OF THE VICE-PRESIDENT AND PRESIDENT PRO TEM, NOVEMBER 1, 1956. Our society has been beset by more than the usual difficulties this past year because of the lateness of our election, in February 1956, and subsequently by the death of President Bergquist on 31 March, 1956. There had been little chance for correspondence with Dr. Bergquist before his death, with the result that I have undoubtedly been unable to fully and properly discharge all of the duties of Vice-President and acting President during the past year. For this I beg your kind indulgence.

Some criticism has been voiced in the past of the conduct of the affairs of the society. Although some criticism may be justified I have learned during the past year that some of our difficulties may not be resolved until our society has further growth, possible reorganization and definition of scope, and increased financial support.

Let us examine some of our problems and look to possible solutions. As one who has served as an officer in a difficult year, many suggestions have been received, and much has been learned, with the recognition that there is a possibility for improvement. I would like to review briefly the several suggestions received for programs this year, inasmuch as the suggestions point up some of our problems.

One of the suggestions for our national program brought forth at the Central Section meeting of the Association of Geology Teachers was that of an "Expanded Business Meeting," in which some of the following might be considered: (1) a further elaboration of the functions of the Association of Geology Teachers; (2) the possibility of a central office and a full time secretary; or (3) How can the Association of Geology Teachers be of greater service to the profession?

These suggestions have much merit and may well be the subject of some future meeting. There is a tremendous amount of correspondence required of both the president and vice-president, although the secretary according to the constitution, "Shall attend to the correspondence of the organization." As is now the case of the Geological Society of America, the American Association of Petroleum Geologists, and the American Chemical Society, it may be necessary to raise additional financial support, hire a full time executive secretary, and establish a permanent office, in order to eliminate some of our problems.

A second suggestion involved consideration of the research potential in Geology Departments,—an elaboration of the National Science Foundation Conference at Beloit, in 1953. This was opposed by some as not in keeping with the aims and functions of the Association of Geology Teachers with which some of you may not agree. If this is the case, some clarification of the strictly professional nature of our organization may be desirable.

A third suggestion involved a further study of geological curricula; this is the program subject upon which we agreed, and I am sure that no one will quarrel with the fact that this is most properly within our province. But again it has been suggested that we do not carry this obligation far enough. Can we continue the fine work started by the committees on geologic education of the Geological Society of America, American Geological Institute, and others which have published several fine reports since 1946.

One of the primary functions or responsibilities of the Association of Geology Teachers as set forth in the constitution is "to foster improvement in the teaching of the earth sciences at all levels." A reasonable corollary to this statement it would seem, is the planning and recommendation of curricula for geological education,—if the quotation, "Improvement in Teaching," is to be significant. It has even been suggested by some that a rigid recommended curriculum be set forth and those schools which conform be placed on an *approved list*, as has been practiced by the American Chemical Society for several years. Again this has been challenged as being too dictatorial.

One of the desirable,—or undesirable (if this is your feeling) effects of a system of no accreditation or recommendation by a professional organization,—is that any school in the country may set up and grant the Bachelor's, Master's, or Doctorate degrees, based only upon the acceptance of their own institution. This is not true in the case of the chemists, or the engineers, who must be inspected and accredited. Although such a system may have its disadvantages, it does have

the advantage of a minimum base level of uniformity, and the great potential advantage of persuading the administration at your own institution to support your department to the extent that it meets minimum requirements of staff, equipment, library, etc.

In my own university I have had the time consuming responsibility during the past few years, to chairman our university curriculum committee, and also a so-called "Self-Study Committee,"—the latter charged with the responsibility of analyzing our over all required curriculum. Here I have learned full well the problems of obtaining agreement among diverse departments and colleges, on what constitutes the rudiments of a college education, especially when pitted against the needs and prejudices of such subdivisions and individuals. However, it has also been very evident that the problems of Research and Teaching are not separable and cannot be pitted against each other; furthermore, we must needs consider "the impending tidal wave of students", rising costs of education, equipment shortages, salaries, research programs—and perhaps even faculty personnel problems and policies. Likewise, for the recommendation and study of geologic curricula to be thorough, we must broaden the organization and scope of the Association of Geology Teachers.

May we not also enlist the support and cooperation of industry in our efforts? In a recent speech by Dr. Maynard Boring, renowned engineering educator, he stated that his company and others have set up funds amounting to millions of dollars to aid educators and educational institutions. What he and they lack is advice on how to proceed with their support.

Today we will continue with a symposium on geological education. In the future, however, may not a broader scope of related subjects be considered in our own organization, especially if it is to be of greater service to the profession?

For the purposes of investigating these criticisms, acknowledging suggestions, and the pursuit of related problems, I wish to here recommend to the executive committee the creation of the two following committees.

I. A committee or committees on the scope and organization of the Association of Geology Teachers, with all that this may involve, as e.g. service to the profession, a central office and executive secretary, our relationship to research *and* teaching, additional financial support, etc.

II. A continuing committee on geological education, working toward the setting up of minimum standards for degrees in geology and its subdivisions, or the several subdivisions of the earth sciences.

Respectfully submitted,

J. ROBERT BERG, *Vice-president and President pro tem.*

MINUTES OF THE BUSINESS SESSION, SIXTH ANNUAL MEETING, NOVEMBER 1, 1957. The meeting, held at the Hotel Nicollet, Minneapolis, Minnesota, was called to order by President pro tem J. Robert Berg at 1:35 P.M. It was moved, seconded and approved that the reading of the minutes of the 1955 meeting would be dispensed with as they were published in the *Journal of Geological Education, Vol. 4, no. 1.*

President Berg announced that Dr. Mildred F. Marple, The Ohio State University, had accepted the editorship of the *Journal of Geological Education* to replace Dr. Anastasia Van Burkalow, who completed a three year term in this capacity.

President Berg announced receipt of a letter from Dr. Higgins, Treasurer, stating he would be unable to attend the meeting. Three recommendations by Higgins were deferred for later discussion. A letter from Dr. James G. Lester, President of the Southeastern Section, was read by Dr. Berg stating his inability to attend the meeting and the assignment of his proxy vote to the Chairman of the meeting.

President Berg announced the reappointment of Dr. Robert L. Bates to serve a second year as AGT representative to the Board of Directors of the American Geological Institute. Dr. Chalmer Roy was appointed as the second representative, to serve a two year term. Dr. Berg also announced that Dr. J. B. Graham had been appointed as an AGT delegate to the Nuclear Science and Engineering Congress.

Secretary Prouty read the Treasurer's report, in the absence of Dr. Charles G. Higgins. As of September 18, 1956 the balance was $509.44. The printing and distribution costs for *Vol. 4, no. 2* of the *Journal* are to be taken from this amount. Incoming payments

from dues and subscription payments will offset a good portion of this expense and some balance should be shown at the end of the fiscal year, on January 24, 1957. A complete financial report will be made at that time.

Prouty gave the Secretary's report. Membership as of November 1, 1956 was 423 compared to 391 a year ago. There were three resignations and three deaths during the year. The Northwestern Section is in the process of developing under the efforts of Edward P. Thatcher, who plans an organizational meeting in late December. The South Plains section is in the embryonic stage and plans have been made for organization in March. Initial steps are underway to develop a Southwestern Section.

President Berg read the presidential address. Berg reviewed the activity of the Association during the year and expressed viewpoints concerning the responsibilities of the Association, especially in taking the lead in formulating satisfactory geological curricula and in accrediting.

Prouty reported for the Nominating Committee in the absence of Robert Webb, Chairman. The results of the ballot for the 1957 officers were as follows:

President: J. Robert Berg, University of Wichita
Vice President: Robert L. Bates, The Ohio State University
Secretary: C. E. Prouty, University of Pittsburgh
Treasurer: John E. Allen, Portland State College

R. M. Foose, AGT representative to the American Association for the Advancement of Science stated that there had been no meeting of this group.

Kurt Lowe, one of the two (Robert L. Bates) AGT representatives to the American Geological Institute reported that the geology career booklets for high school and college, being prepared by the AGI, should be ready by next fall. He also mentioned the need for financial support from affiliated societies of the AGI. After discussion, a recommendation to approve a contribution of 10% ot the annual dues be made to the AGI was passed. The recommendation that this matter be turned over to the Executive Committee for study before circulation for general membership action was approved. Lowe announced that as an affiliate of AGI our association should act on the application of the Geochemical Society for affiliation with the AGI. The motion was carried unanimously.

The recipient of the Neil Miner Award for 1956 was Armin K. Lobeck, retired, Columbia University. As Dr. Lobeck was unable to attend the meeting to accept the award, Richard Mahard, Denison University, received the award in his behalf.

President Berg mentioned the Neil Miner committee for 1957. John B. Lucke, University of Connecticut, will serve as hold-over member; and Sidney E. White, The Ohio State University, and Richard Mahard, Denison University will serve as the two new members of the Committee and complete the three members-at-large. The balance of the Committee according to custom was to be comprised of the new President (chairman), Secretary, and past-president (vacant in this case due to the death of Dr. Bergquist).

Roger Spitznas read a letter drafted by the Central Section in which that section is offering a Leland Horberg Memorial Fund to the Association in the order of $300 to "promote better teaching." The award was accepted with gratitude.

President Berg brought up the subject of the three proposals submitted by Treasurer Higgins: (1) Clarification of policy regarding mailing of the *Journal of Geological Education* to members whose dues are in arrears (2) Reevaluation of discounts to agencies handling *Journal* subscriptions, and (3) Clarification of the dues year as it relates to rights of members to receive the *Journal.*

Time prohibited action on these recommendations and it was moved, seconded and carried that the recommendations be referred to the Executive Committee for consideration.

The business meeting adjourned at 2:30 P.M.

MINUTES OF THE EXECUTIVE COMMITTEE BREAKFAST MEETING, NOVEMBER 1, 1956. *Present:* Bates, Berg, Hussey, Lowe, Prouty. *Absent:* Foose, Higgins, Lester (sent proxy), Moss, Richmond, Shideler, Trefethen, Wickwire.

The meeting began at 7:45 A.M. The agenda for the 1:30 P.M. business meeting was discussed. It was decided not to place on the agenda a discussion of the addition of

"National" or "American" to the name of our Association.

Three proposals by Treasurer Higgins submitted by mail were considered too lengthy for consideration in the available time at the business meeting and it was recommended that they would be referred later to the Executive committee in writing for consideration.

Lowe, as the Association representative to AGI, mentioned the possibility of financial contribution to the AGI. President Berg mentioned a $300 contribution to the AGT from the Central Section as a memorial to Leland Horberg.

Bates brought up the subject of a membership drive. Lowe considered the responsibility to be largely that of the sections. It was agreed to discuss the possibility of erecting a Membership Committee at the business meeting.

Lowe mentioned the possibility of a standing committee of the AGT to help the AGI committee on Education and Public Relations. Berg suggested the AGT representatives on the AGI Board of Directors (Bates and Roy) serve as liaison between the two groups.

The meeting adjourned at 8:45.

C. E. PROUTY, *Secretary.*

REPORT OF THE SECRETARY. Soon after the change of national officers, the Secretary corresponded with President Bergquist calling to his attention unfinished business from the previous year and new orders of business. The untimely death of Dr. Bergquist placed the responsibility upon Vice-President Berg who assumed the position of President pro tem. It was necessary for Dr. Berg and the Secretary to determine what had and had not been accomplished at the time of Dr. Bergquist's death. The Secretary circulated the ballots for the 1957 slate of officers upon receipt of the nominees from the Nominating Committee in early October. Although the Chairman of the Nominating Committee had started action early in the summer, difficulty in contacting the other committee members, one of whom was in Alaska, caused some delay in formulation of the final ballot. Insufficient time was available to obtain two candidates for each office. For this reason, the usual two candidates were available for only one of the offices, the others appearing on the ballot with a single candidate and the option for a write-in candidate. The Secretary has received a number of letters from members stating their preference for single candidates for each position with write-in privileges. This is a matter for future consideration by the members.

Membership in the Association at this date is 423 as compared to 391 a year ago. During the year three were lost by death, three by retirement. It is recognized that the membership represents only a small fraction of the potential and more effective means of recruitment are under study. A revised membership list was sent to the Executive Committee and to the various sections in May 1956. A newly revised list is planned for the spring of 1957. There was some activity during the year toward the organization of new sections. A temporary Northwestern Section, Marie Pabst, President and E. P. Thatcher, Secretary-Treasurer was set up during the past year. An organizational meeting is planned for December at the time of the meeting of the Northwest Scientific Society in Spokane, Washington. The South Plains section is in the embryonic stage of development. John G. W. Rodgers and William Muehlberger have been active in promoting interest and an organizational meeting is planned at the time of a field conference in March 1957. The Southwestern Section is in the initial stage of development largely due to the efforts of John Chronic. No definite organizational meeting has been planned as yet.

The Association was represented by two delegates at the International Geological Congress in Mexico. They were R. M. Foose and Bradford Willard.

Respectfully submitted,
C. E. PROUTY, *Secretary.*

NOMINATING COMMITTEE FOR 1957. The following have been appointed as a committee to nominate national officers for 1957; James G. Lester, Emory University, Southeastern Section; C. T. Bressler, University of Oregon, Pacific Northwest Section; Ian Campbell, California Institute of Technology, Far Western Section; Donald C. Boardman, Wheaton College, Central Section; John C. Ludlum, West Virginia University, Eastern Section; V. E. Nelson, University of Kentucky, East-Central Section; Arthur A. Socolow, Massachusetts State, New England Section.

THE ASSOCIATION OF GEOLOGY TEACHERS was founded in the Middle West in May, 1938. In November, 1951, it was organized as a national association, under which there are at present seven organized regional sections: Central, East Central, Eastern, New England, Far Western, Southeastern, and Pacific Northwest. An annual meeting of the national association is normally held in the fall, and sectional meetings are held in the spring.

The purpose of the Association, as stated in its Constitution, is "to foster improvement in the teaching of the earth sciences at all levels of formal and informal instruction, to emphasize the cultural significance of the earth sciences, and to disseminate knowledge in this field to the general public."

Anyone concerned with geological education, formal or informal and at any age level, is invited to apply for membership. *Inquiries should be addressed to the national secretary,* C. E. PROUTY, Department of Geology, University of Pittsburgh, Pittsburgh 13, Pennsylvania.

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